LE910Cx-WE866Cx

LTE Bundling User Guide

1VV0301578 Rev. 11 – 2021-04-27

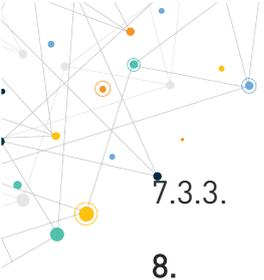## APPLICABILITY TABLE

PRODUCTS
WE866C3-P
WE866C6-P
LE910Cx SERIES

Not Subject to NDA

CONTENTS

Not Subject to NDA

Not Subject to NDA

1. INTRODUCTION

1.1. Scope

This document provides information required to setup and run the Telit LE910Cx + WE866Cx LTE module.

1.2. Audience

This document is intended only for Telit customers who want to set up a bundling application using LE910Cx + WE866Cx LTE module.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- *TS-EMEA@telit.com*
- *TS-AMERICAS@telit.com*
- *TS-APAC@telit.com*
- *TS-SRD@telit.com*

Alternatively, use:

https://www.telit.com/contact-us

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

https://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates the user feedback on our information.

1.4. Symbol Conventions

	Danger: This information MUST be followed or catastrophic equipment failure or personal injury may occur.
	Warning: Alerts the user on important steps about the module integration.
	Note/Tip: Provides advice and suggestions that may be useful when integrating the module.
	Electro-static Discharge: Notifies the user to take proper grounding precautions before handling the product.

Table 1: Symbol Conventions

All dates are in ISO 8601 format, that is YYYY-MM-DD.

1.5. Related Documents

- WE866C3 Hardware Design Guide, 1VV0301495
- WE866C6 Hardware Design Guide, 1VV0301495
- WE866Cx M.2 Interface Adapter Hardware User Guide, 1VV0301533
- Telit Evaluation Board Hardware User Guide, 1VV0301249
- LE910Cx Multi Technology Interface Board TLB Hardware User Guide, 1VV0301508
- LE910Cx AT Command Reference Guide, 80502ST10950A

2. OVERVIEW

Telit's WE866Cx is a low power, high bandwidth 802.11ac and Bluetooth 4.2 module with a small footprint that provides an easy and cost-effective way to achieve best possible wireless connectivity. The advanced coexistence of LTE, Wi-Fi and Bluetooth dramatically reduces the complexity of cellular back haul design with the LE910Cx 4G LTE module family, making the WE866Cx module ideal for a wide range of IoT applications including commercial building automation, OEM telematics, fleet management, and video surveillance.

WE866Cx powered by the Qualcomm QCA9377-3 is a perfect companion device for Telit LE910Cx cellular modules. WE866Cx supports low-power SDIO 3.0 interface for WLAN and a UART/PCM interface for Bluetooth. WE866Cx also supports BT-WLAN coexistence and uses the 2 wire ISM-LTE coexistence interface.

The following diagram shows a basic connection of LE910Cx with WE866Cx module over the Wi-Fi interface.
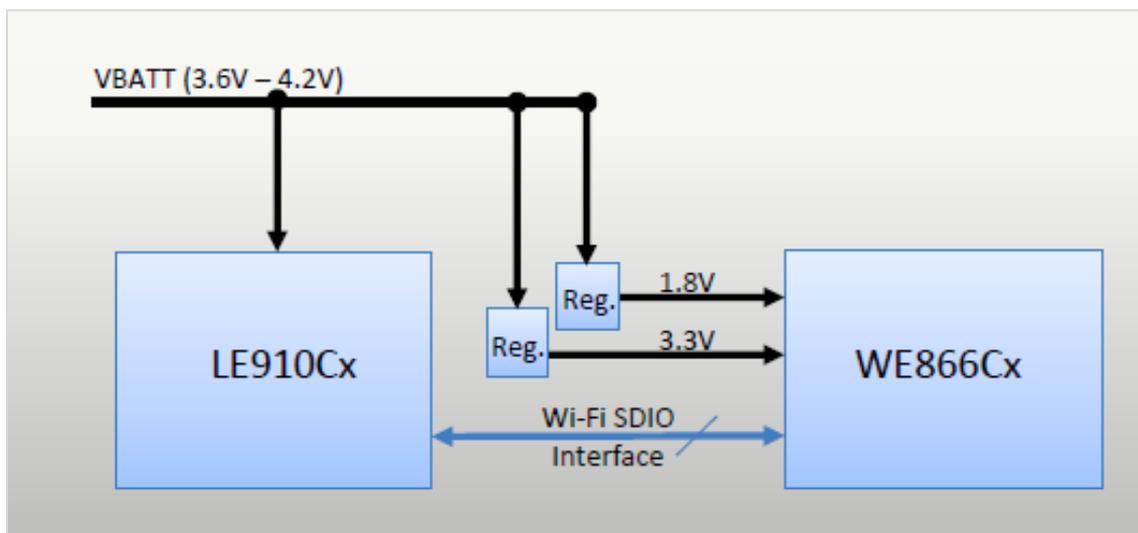
Figure 1: LE910Cx-WE866Cx Block Diagram

3. FEATURES

3.1. Specification Overview

- Dual-Band 1x1 Wi-Fi + BT module based on QCA9377-3

- 802.11 a/b/g/n/ac

  o Up to 40Mhz channel BW for 2.4G (802.11n)

  o Up to 80Mhz channel BW for 5G (802.11ac)

  o Max TpT ~215Mbps

- BT4.1 + HS + BLE

- 3.3V main input

- VCCIO input for flexible interface voltage control 1.8V/3V (SDIO, UART, PCM)

- Support for AP and STA modes

- Size: 15mm x 13mm x 2.15mm

  o T&R packaging only (200 units per reel)

- Temperature Range: -40°C => 85°C

  o No reliability testing planned.

802.11 PHY Specification Overview								
802.11 Protocol	Release Date	Frequency (GHz)	Bandwidth (MHz)	Data Rate (Mbit/s) *SGI	MIMO streams	Modulation	Range (m)	
							Indoor	Outdoor
b	Sept'99	2.4	22	11	SISO	DSSS	32	140
a	Sept'99	5	20	54	SISO	OFDM	38	120
g	June'03	2.4	20	54	SISO	OFDM	38	140
p	July'10	5.8	5/10	27	SISO	OFDM	35	120
n	Oct'09	2.4/5	20	72.2	4	OFDM	70	250
			40	150				
ac wave1	Dec'13	5	20	96.3	8	OFDM	35	-
+			40	200				
wave2			80	433.3				
			160	866.7				
ad	Dec'12	60	2160	6912	SISO	OFDM, SC, LP-SC	60	100

802.11 PHY Specification Overview								
802.11 Protocol	Release Date	Frequency (GHz)	Bandwidth (MHz)	Data Rate (Mbit/s) *SGI	MIMO streams	Modulation	Range (m)	
							Indoor	Outdoor
ax	Jul-19 (Draft 1.Jan17)	2.4/5	20	143	8	OFDMA	35	-
			40	2.87				
			80	600				
			160	1201				

Table 2: 802.11 PHY Specification Overview

3.2.   Data Rate

- 802.11a (5GHz): 6, 9, 12, 18, 24, 36, 48, 54Mbps

- 802.11b (2.4GHz): 1, 2, 5.5, 11Mbps

- 802.11g (2.4GHz): 6, 9, 12, 18, 24, 36, 48, 54Mbps

- 802.11n (2.4GHz/5GHz):

    o   20Mhz BW: Up to 72.2Mbps using short GI (MCS0-7)

    o   40Mhz BW: Up to 144.4Mbps using short GI (MCS0-7)

- 802.11ac (5GHz):
    o   HT20 (MCS0-8), VHT40 (MCS0-9), VHT80 (MCS0-9)

- 802.11a/54Mbps: 13 dbm

- 802.11b/11Mbps: 1820.5 dbm

- 802.11g/54Mbps: 158 dbm

- 802.11n/HT20 (MCS7): 157.5 dbm

- 802.11ac/HT20 (MCS0): 175.5 dbm

- 802.11ac/VHT40 (MCS9): 11.5 dbm

- 802.11ac/VHT80 (MCS9): 101.5 dbm

3.3.   Wi-Fi Interface

The Wi-Fi Interface is part of the Baseband System of the cellular module. This section describes the method to connect the Wi-Fi interface to WE866Cx module. The Wi-Fi Interface is a dedicated SDIO interface that is used as a communication channel to the Modem chipset.

The tables below describe the Wi-Fi interface for the various cellular modules.

Pin	Signal	I/O	Function	Type	Comment
L12	WIFI_SDRST_TGPIO13	O	WLAN RESET	CMOS 1.8V	
N13	WIFI_SDCMD_TGPIO14	I/O	SDIO CMD	CMOS 1.8V	
J13	WIFI_SD0_TGPIO15	I/O	SDIO DATA 0	CMOS 1.8V	
M13	WIFI_SD1_TGPIO16	I/O	SDIO DATA 1	CMOS 1.8V	
K13	WIFI_SD2_TGPIO17	I/O	SDIO DATA 2	CMOS 1.8V	
H13	WIFI_SD3_TGPIO18	I/O	SDIO DATA 3	CMOS 1.8V	
L13	WIFI_SDCLK_TGPIO19	O	SDIO CLOCK	CMOS 1.8V	

Table 3: Wi-Fi interface for the various cellular modules

3.4. Hardware Interface

- Single antenna port

- 4-bit SDIO3.0 for Wi-Fi host interface (up to 200Mhz)

- 4 pin UART for BT interface

- 32KHz input for Wi-Fi sleep

- LTE Coexistence interface (2 pin WCI UART)

- Control pins (Enable input, WoW Output)

- Debug UART (TX only)

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4. HARDWARE

This section describes the hardware components of the LE910Cx +WE866Cx LTE module.

4.1.   Telit Evaluation Board

The Telit Evaluation Board is a generic developer's platform, designed to provide the user with the complete development environment and intended to be used with a new set of Telit IoT modules. The EVB is designed to carry an Interface Board (IFBD) via three 120-pin B2B connectors. The Telit module is mounted directly on the IFBD. Power supply and control interface to the IFBD module are provided by the EVB via the B2B connectors. Several power supply configurations, including battery charging, are available. In addition, all interfaces needed for the developers, such as SIM card holders, JTAG, UART, USB, audio, micro SD, and so on are available on the EVB main board.

The following image shows an example of the generic Telit Evaluation Board.
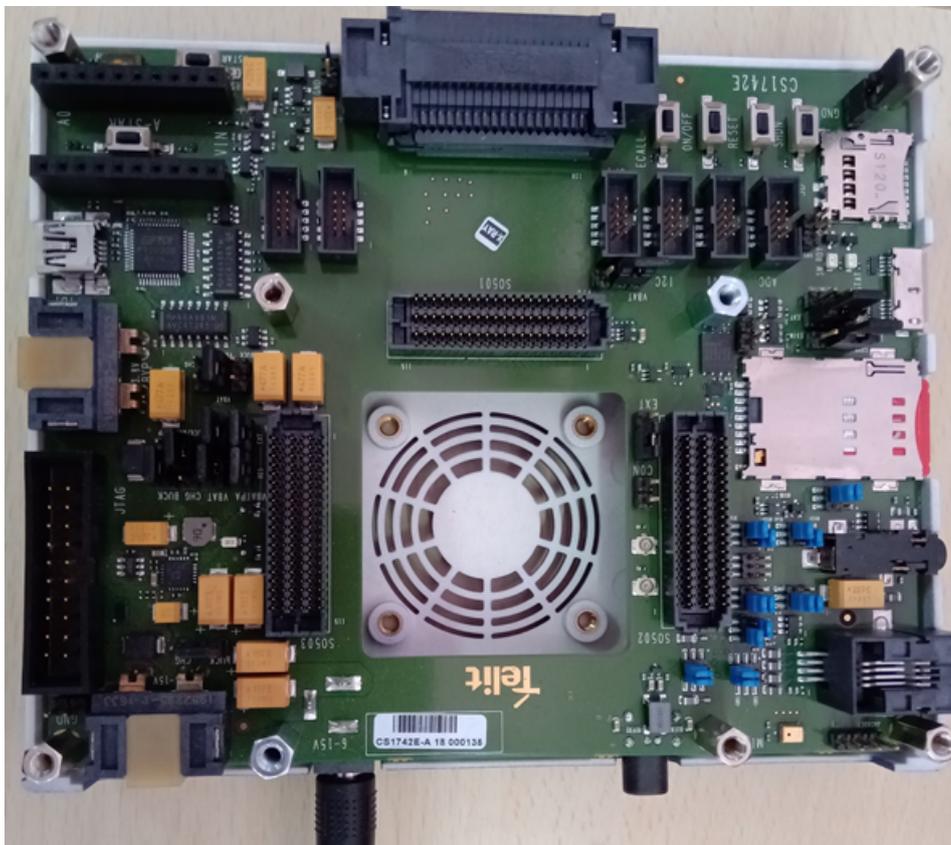

Figure 2: Generic Telit EVB Board

4.2.   Multi Technology Interface Board

The MultiTech Interface Board TLB (aka MTB) is custom designed to interface the Telit module variant LE910Cx with the Telit Generic Evaluation Board (EVB) thus forming the

complete Development Kit of LE910Cx which allows great flexibility for integrating WIFI, BT and GPS technologies with the LE910Cx.

The MTB provides the mapping of Telit module signals and functions into the generic EVB signals and functions.

The TLB design of the MultiTech Interface Board includes the following items:

- LE910Cx module.

- 3x M.2 type mini card slots.

- Programmable FPGA.

- RF SMA connectors.

- Board to Board connectors for interfacing to EVB main board

- Module specific circuitry which is not part of the generic circuitry of the EVB

Power supply and control interface for the cellular module is provided by the EVB via the B2B connectors.

To monitor the temperature, a thermistor is placed on the top GND plane, close to the module which should be representative of the module's backside temperature.

A programmable FPGA included in the MTB provides options for connecting very functional modem pin to the relevant peripheral M.2 cards hence enabling the most flexible way to demo interoperability between the LE910Cx module and the peripheral accessories.

A typical example of this capability is in the case where 3x M.2 cards (WIFI module, GNSS module and BT module) are plugged into the M.2 slots while the FPGA is programmed to perform the correct signals mapping between the LE910Cx and the interfaces of each of the M.2 accessories.

The following images show the MultiTech Interface Board top and bottom views:

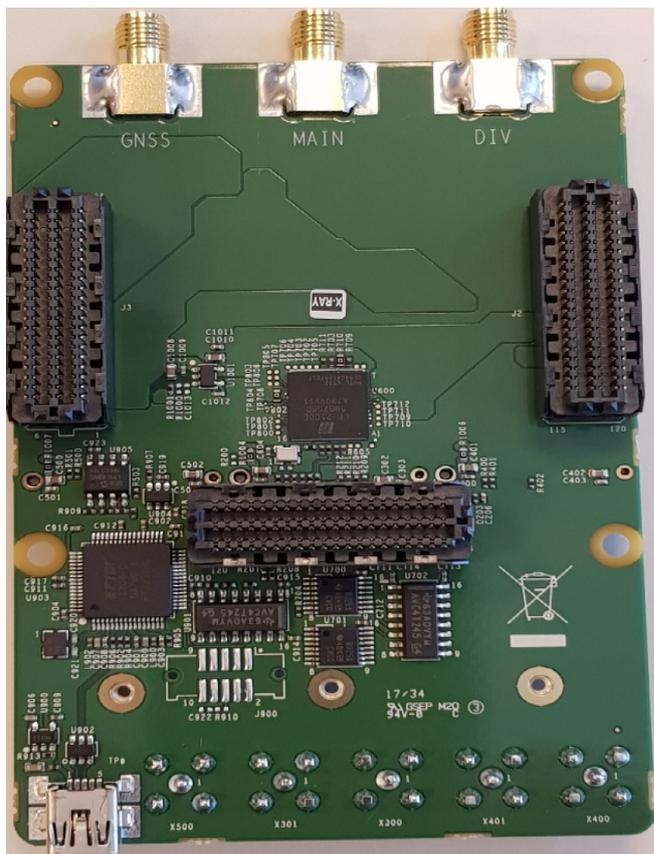Figure 3: MultiTech Interface Board - Top View

Figure 4: MultiTech Interface Board - Bottom View

For detailed description, refer LE910Cx Multi Technology Interface Board TLB – HW User Guide.

4.3. WE866Cx M.2 Card

The M.2 card is designed to interface the Telit LE910Cx module family on an IFBD with the Telit Generic Evaluation Board (EVB) thus forming a complete Development Kit of LE910Cx.

The following image shows the top view of the M.2 card mounted with a WE866Cx module.

Figure 5: WE866Cx M.2 Card

The WE866Cx M.2 card follows the below M.2 specification:

- SDIO based Socket 1
- 2230 size type
- Key type E

This form-factor card specification is intended to support Wireless Connectivity devices including combinations of Wi-Fi, BT, NFC, and/or GNSS.

The card includes a U. FL miniature RF connector for connecting a compatible wi-fi antenna.

For detailed description of the M.2 Card, refer WE866Cx M.2 Interface Adapter Hardware User Guide.

The following image shows the M.2 plugged into the MTB.

Figure 6: M.2 Plugged into MTB

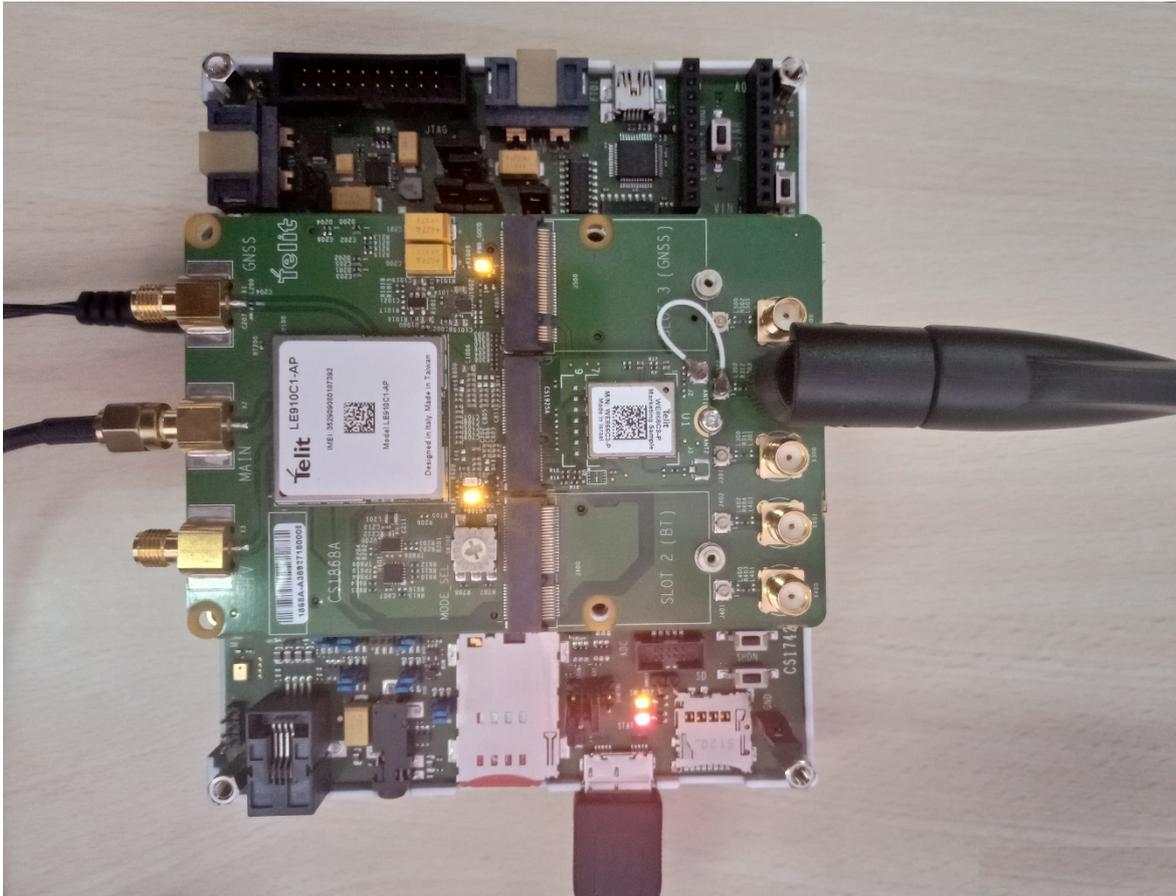The final assembly of the LE910Cx + WE866Cx module is as shown below:

Figure 7: Final Assembly

5. SET UP

5.1.   Prerequisites

5.1.1.   Hardware Requirements

- Telit Evaluation Board
- Multi Technology Interface Board
- M.2 Card
- One USB3.0 Micro-B port cable
- One 12V 1.25 Amps Power Adapter
- A SIM card with data connectivity.

5.1.2.   Software Requirements

- WHQL Drivers
- A serial terminal such as TATC (Telit AT Controller) to communicate over the COM interface.

5.2.   Installing WHQL Drivers

1) Go to URL: *https://www.telit.com/evkevb-drivers/* and download the Windows Hardware Quality Labs (WHQL) drivers as shown below.
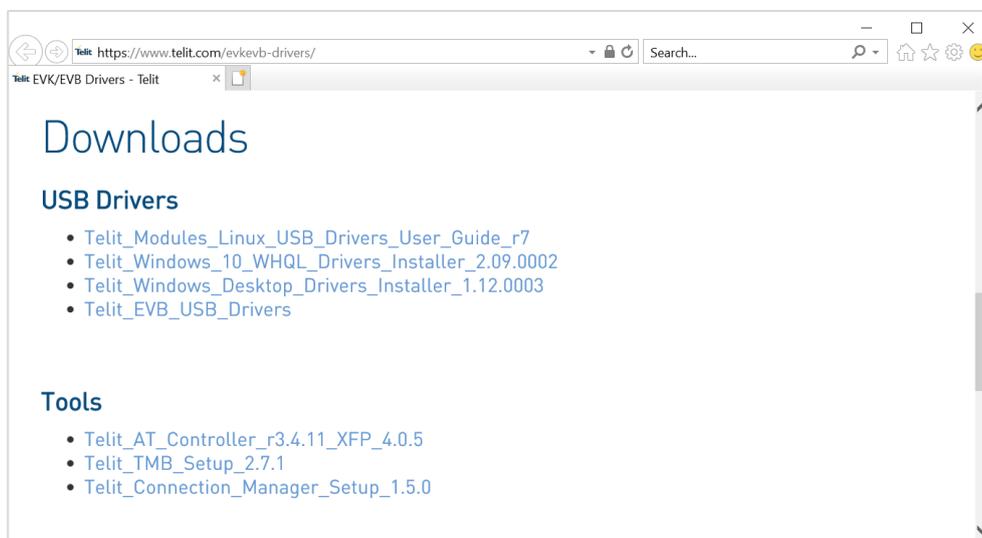

Figure 8: Downloading Telit WHQL Drivers

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2) Unzip the "Windows10WHQLDriversInstaller_2.09.0002.zip" file and extract the windows installer package depending on your host system architecture:

- x86: Telit WHQL Drivers x86
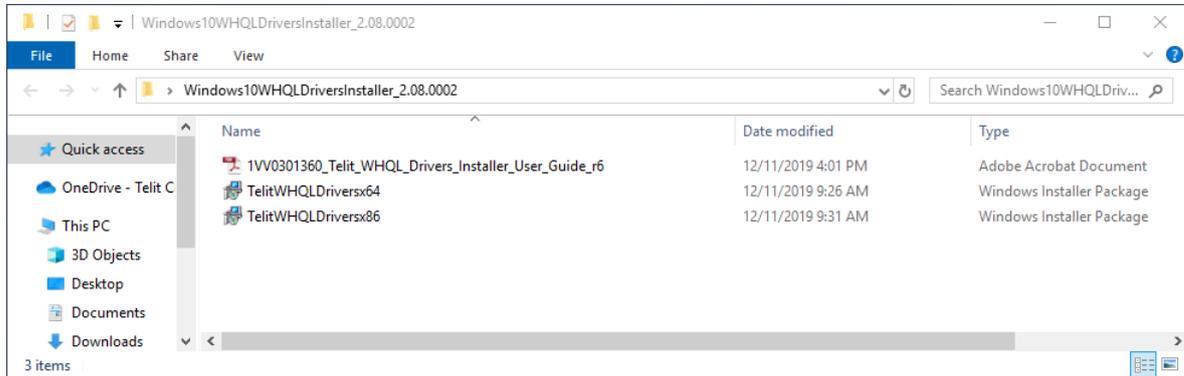
- x64: Telit WHQL Drivers x64

Figure 9: WHQL Driver Package

3) To start the installation process, double-click and open the windows installer package and run the Installation wizard.

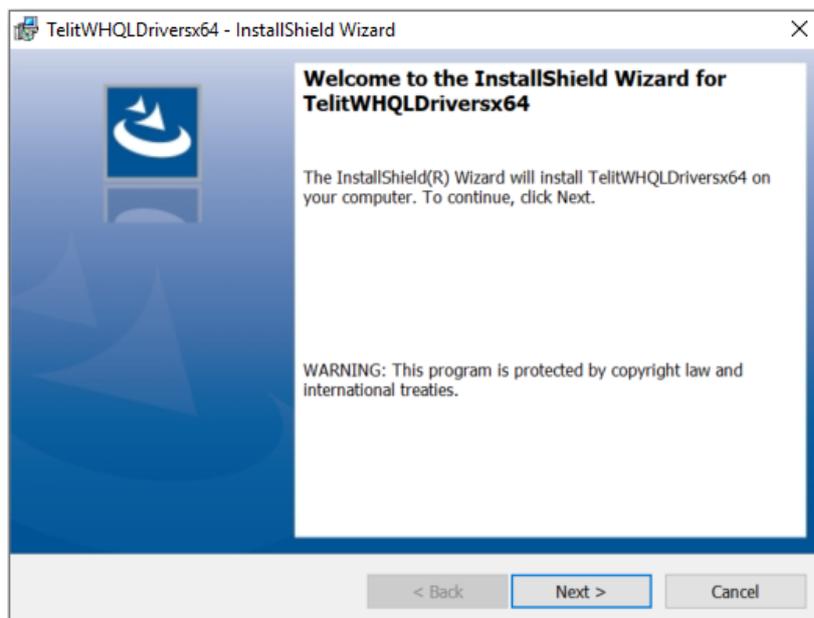4) The Welcome screen displays. Click **Next** to continue.

Figure 10: Telit WHQL Driver Installation

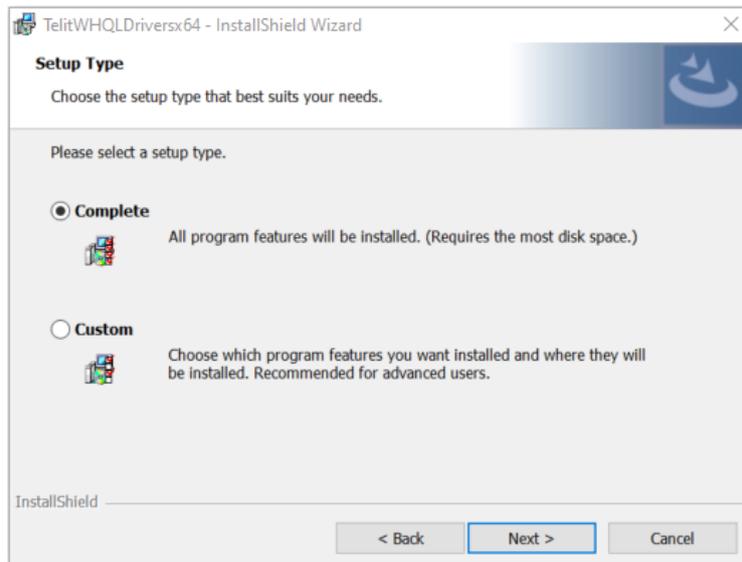5) Select a **Setup Type** and click **Next**.

Figure 11: Select Setup Type

6) The ready to install Telit WHQLDriversX64 dialog displays. Click **Install** to continue the installation process.
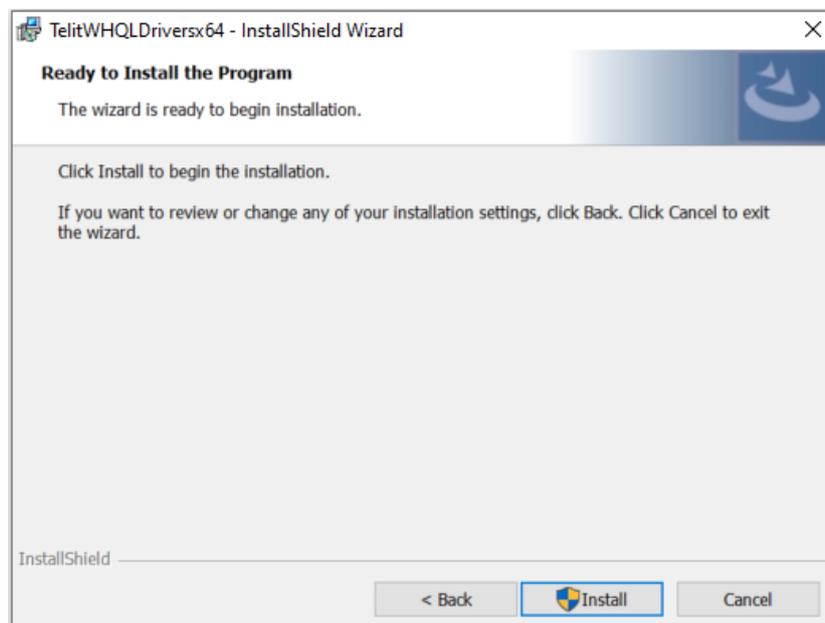

Figure 12: TelitWHQLDriversx64 Begin Installation

7) The progress window displays the status of the InstallShield wizard.
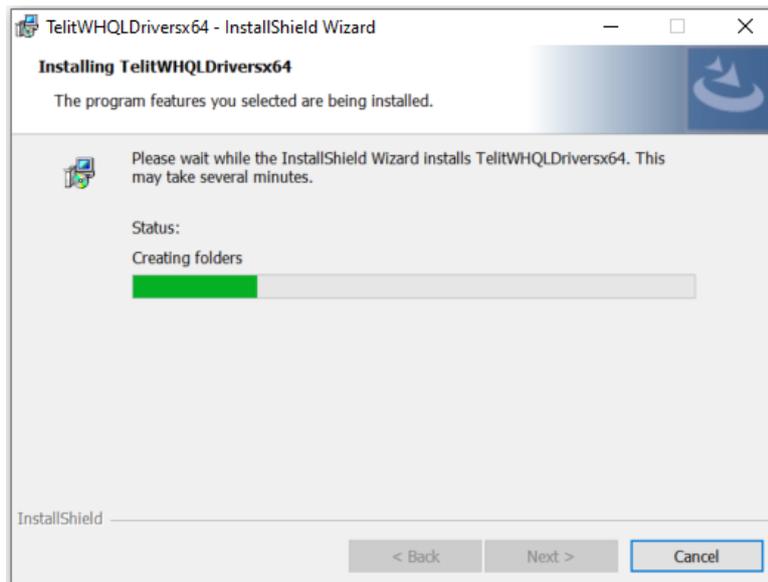
Figure 13: WHQLDriversx64 Installation in Progress

8) When finished, the wizard displays the Completed the TelitWHQLDriversx64 Setup Wizard dialog.
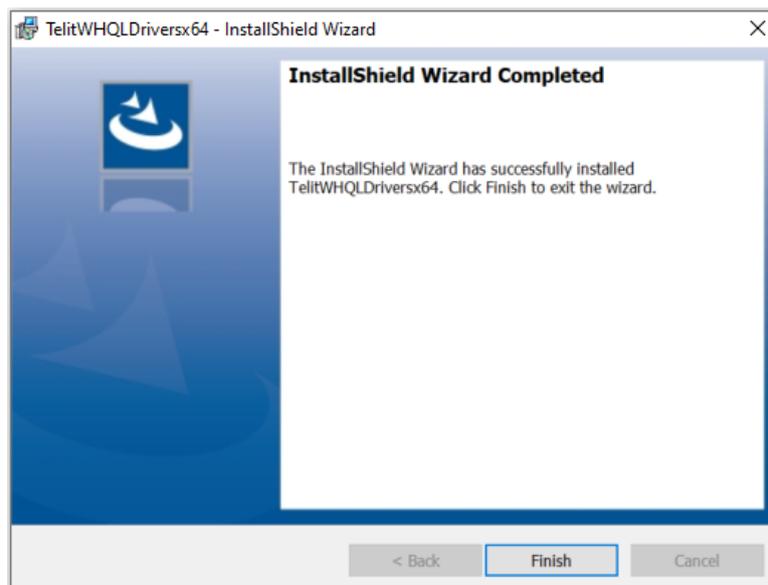
Figure 14: WHQLDriversx64 Installation Completed

9) Upon successful software installation, following devices will be listed under Device Manager.
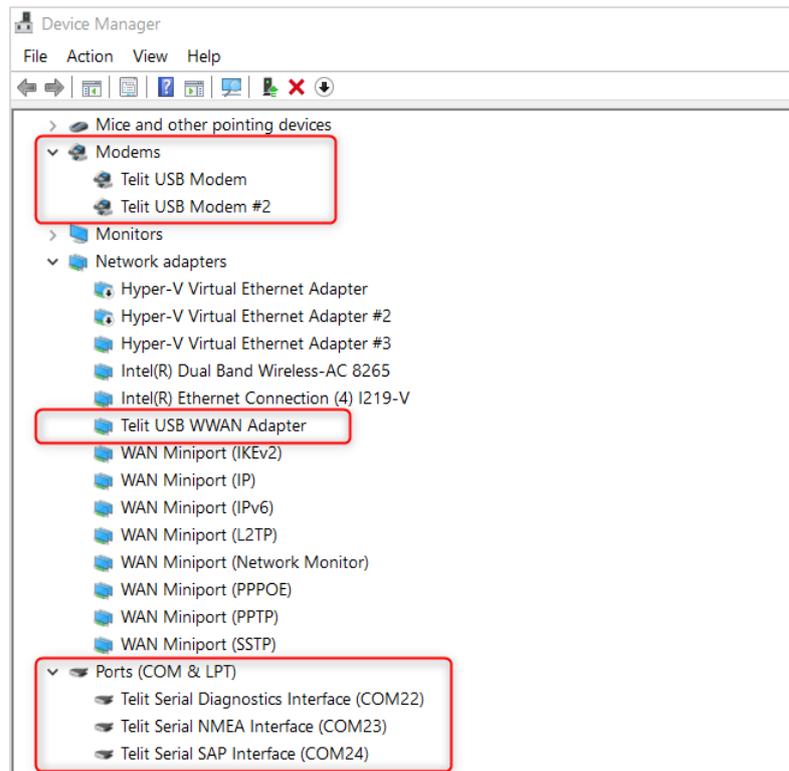
Figure 15: Installed Devices List in Device Manager

5.3. Installing TATC Tool

1) Go to URL: *https://www.telit.com/evkevb-drivers/* and download the Telit TATC tool package as shown below.

Note: The Telit TATC package consist of:

- Telit AT Controller.lnk

- Xfp.lnk
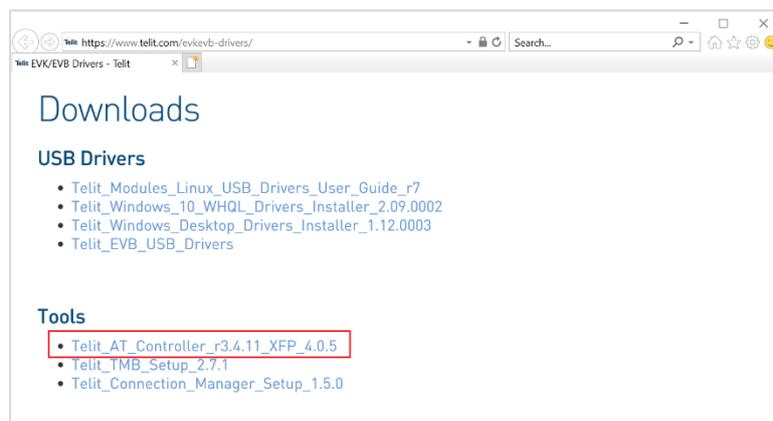
Figure 16: Telit TATC Package

2) To start the installation process, double-click and open the downloaded Setup_TATC_3.4.11_XFP_4.0.5.msi file and run the TATC Setup Installation wizard.
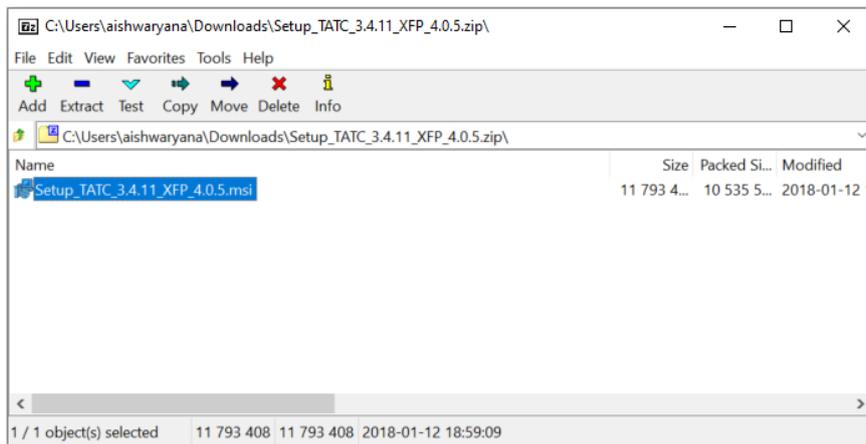
Figure 17: TATC Setup Files

3) The Welcome screen displays. Click **Next** to continue.
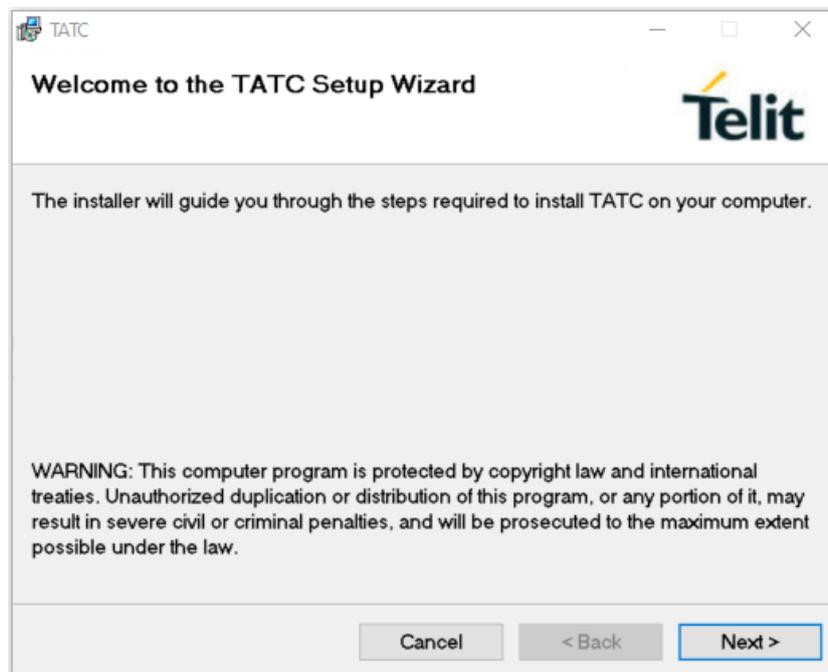
Figure 18: Begin TATC Setup Installation

4) Accept the End User license agreement. Select the **I agree** option and click **Next** to continue.

Figure 19: TATC - Accept End User License Agreement

5) Before proceeding further, verify the instructions as shown below.
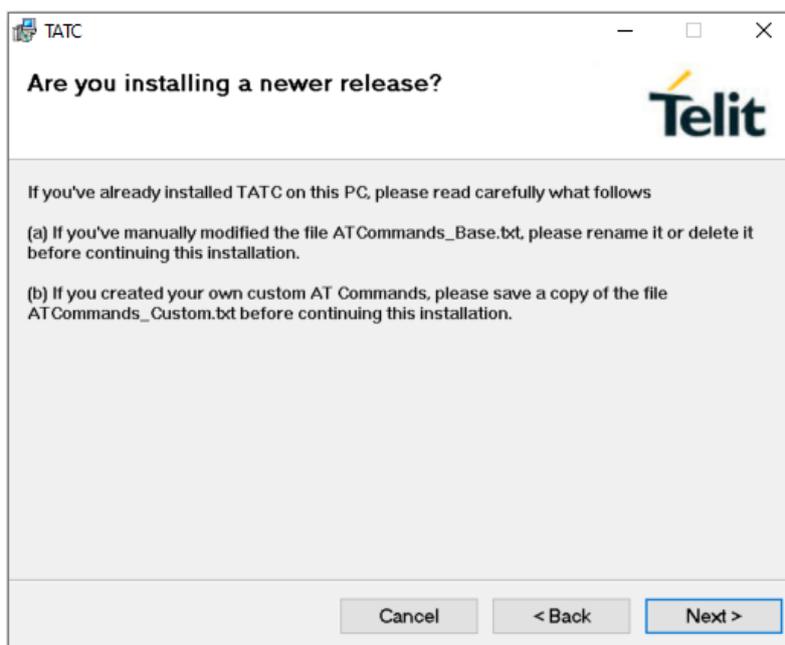
Figure 20: Verifying Installation of a New Release

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8) The progress window displays the status of the TATC Setup wizard.
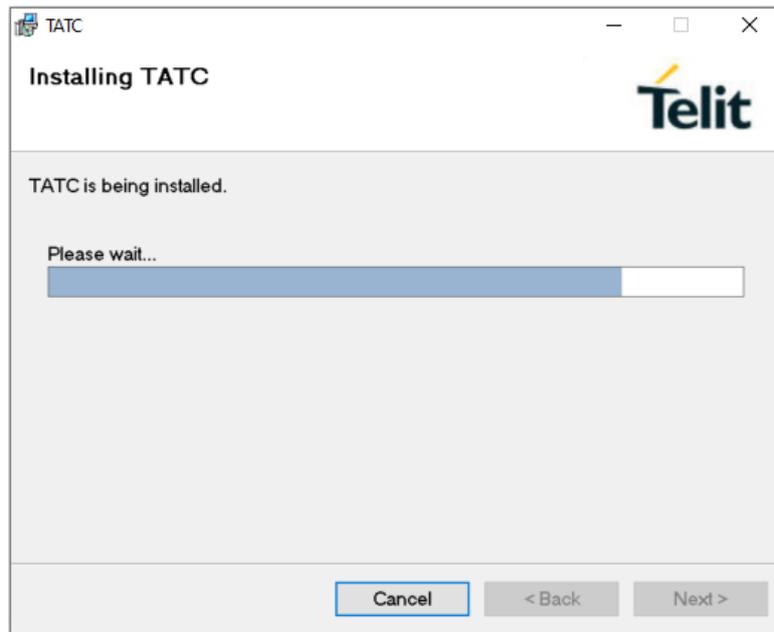
Figure 23: TATC Installation in Progress

9) When finished, the setup wizard displays the **Installation Complete** dialog.

By default, the **Install Xfp** checkbox is selected. Click **Close** to Exit.

Once you click **Close**, the Xfp Setup Wizard displays.
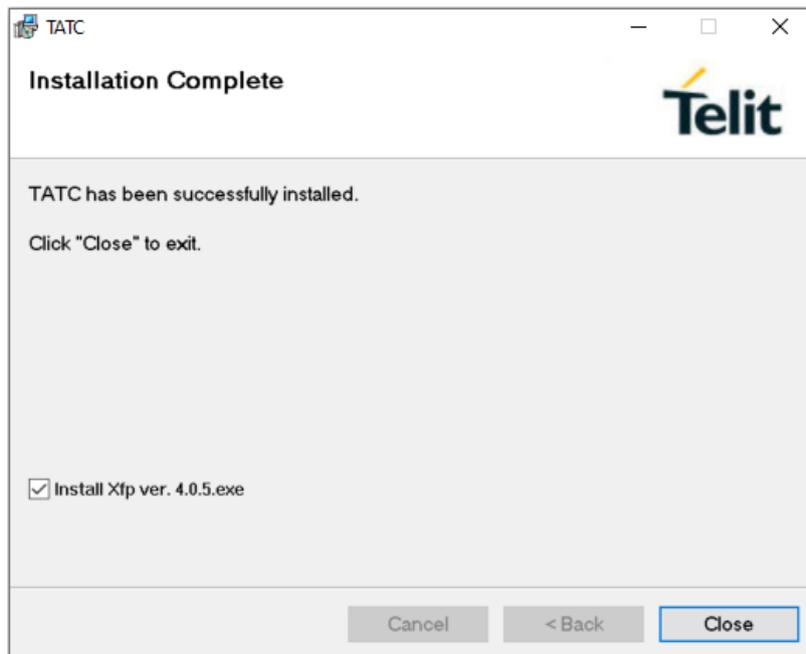
Figure 24: TATC Installation Completed

Not Subject to NDA

10) Accept end user license agreement. Select the **I accept the agreement** and click **Next** to continue.
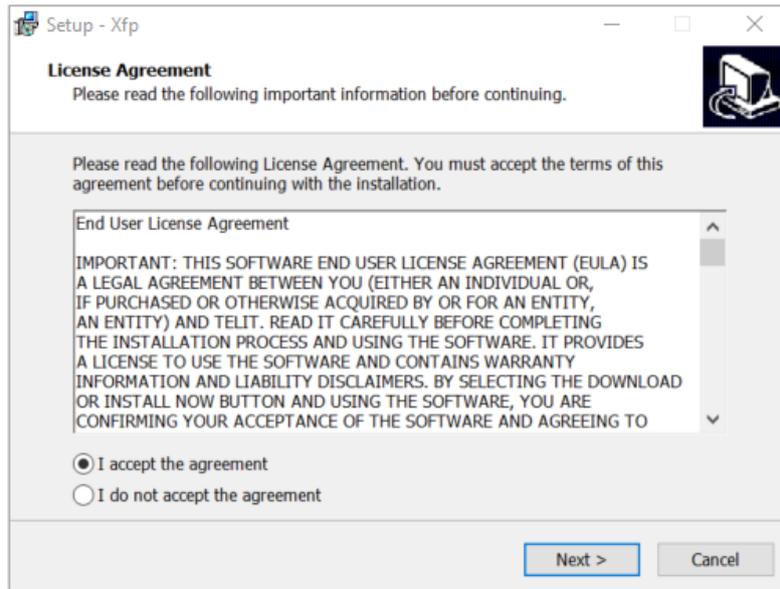
Figure 25: Xfp - Accept End User License Agreement

11) Choose the destination folder to install the Xfp application file and click **Next**.
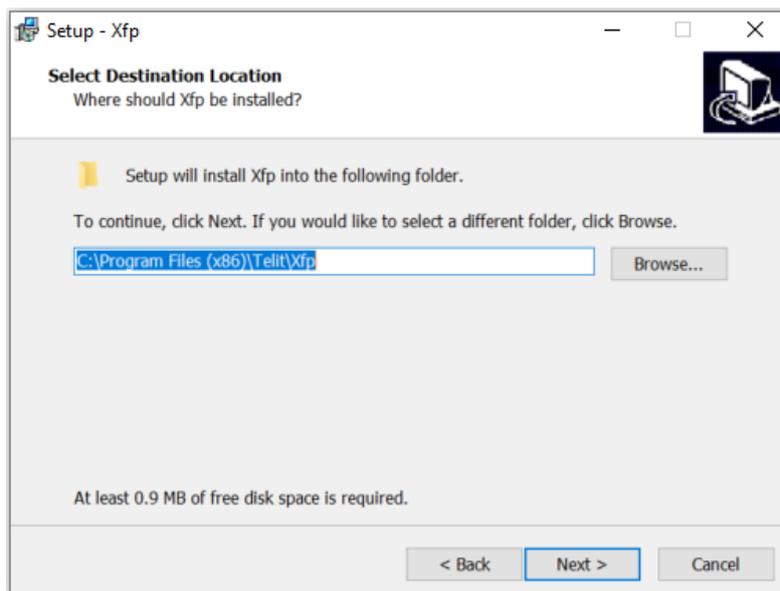
Figure 26: Xfp - Select the Destination Folder

12) You have an option of setting up a standard program shortcut or to select the location. Click **Next** to continue.
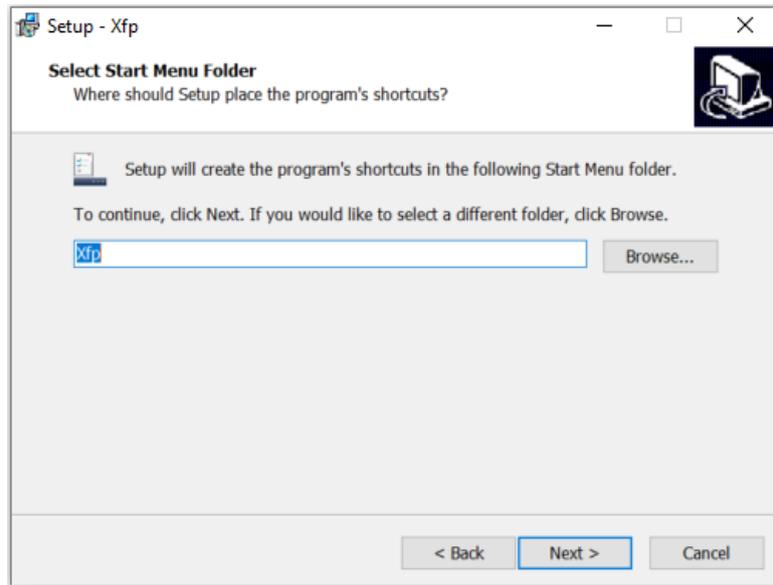
Figure 27: Xfp - Shortcut to Start Menu Folder

13) The **Ready to Install** Xfp dialog displays. Click **Install** to continue the installation process.
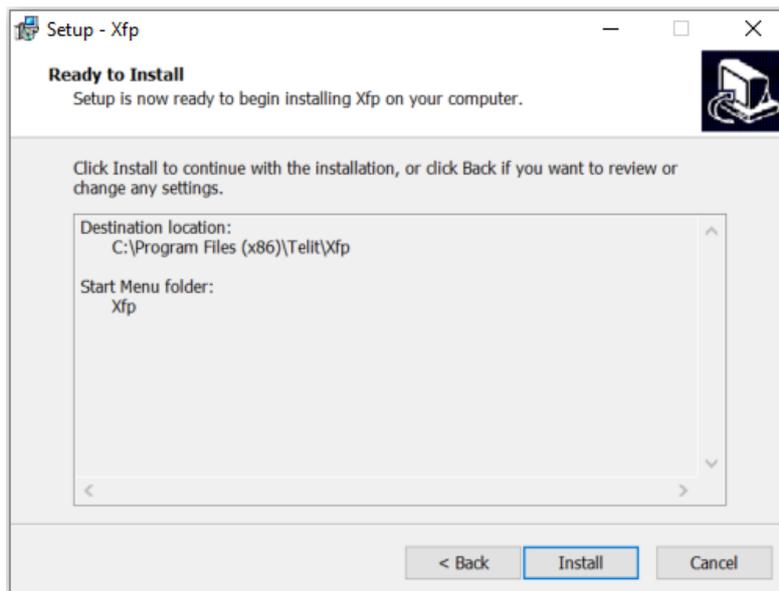
Figure 28: Begin Xfp Installation

14) When finished, the wizard displays the **Completed the Xfp Setup Wizard** dialog.
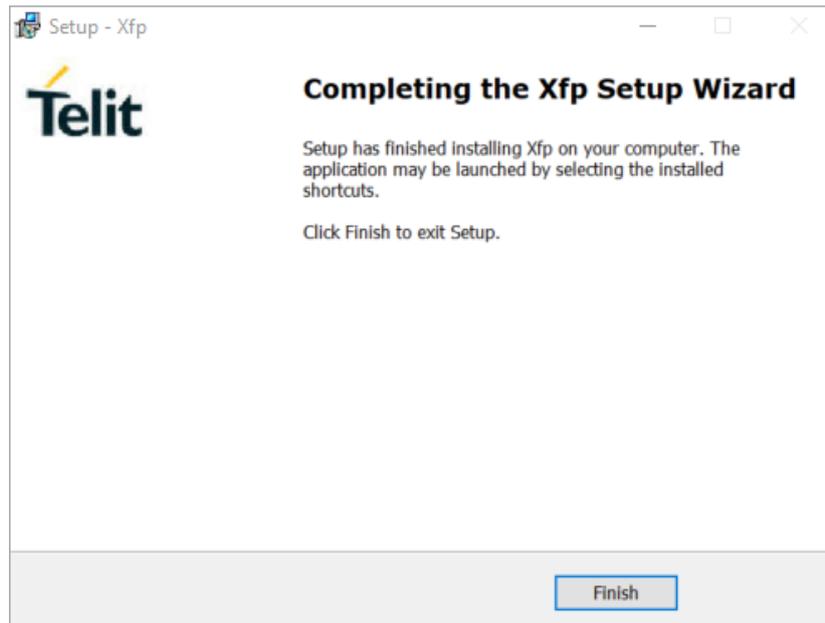
Figure 29: Xfp Installation Completed

15) Upon successful software installation following desktop icons are created on your desktop:

1. Telit AT Controller.lnk

2. Xfp.lnk

5.4.   Start Up

1) Plug the MultiTech Board on the generic EVB and insert the WE866Cx M2 adapter and power it ON.

Figure 30: LED Glowing after Successful Connection

2) Connect one end of the USB3.0 Micro-B port in EVK and other end to the USB port of the PC. This USB connection is used to establish a UART communication with a PC over a virtual COM port.

3) Connect the power supply cable to the generic EVB [6-15 V]. The two (DBG1 and D1000) Orange LED's glows on the MTB, this indicate that the power supply is good for MTB to run.

4) Press and hold the ON/OFF button [6] on the EVB for 1 seconds and release it, you will see that DBG1 [1] and DBG2[3] start blinking. On successful boot "SW RDY" [4] (Orange LED) and STAT [5] (Red LED) will glow on EVB.
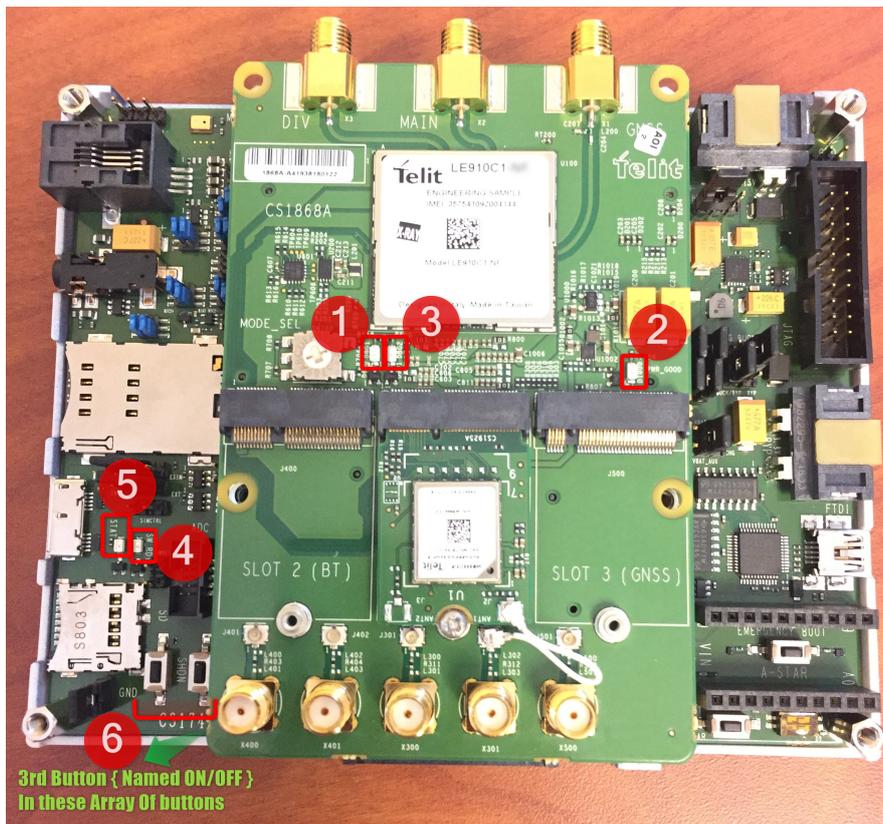
Figure 31: Successful Boot-up

5) Now the board is ready for Connecting AT Controller tool. Use Telit AT Controller to communicate with the WE866Cx module.

5.5. Configuring WE866Cx Module

1) Assuming all settings are set properly, you should be able to communicate with the module. The Telit AT Controller can be used to read or modify the configuration settings.

Figure 32: Telit AT Controller Main Menu

2) Click the **Settings** button to select the COM port (Telit USB modem) assigned to the module.
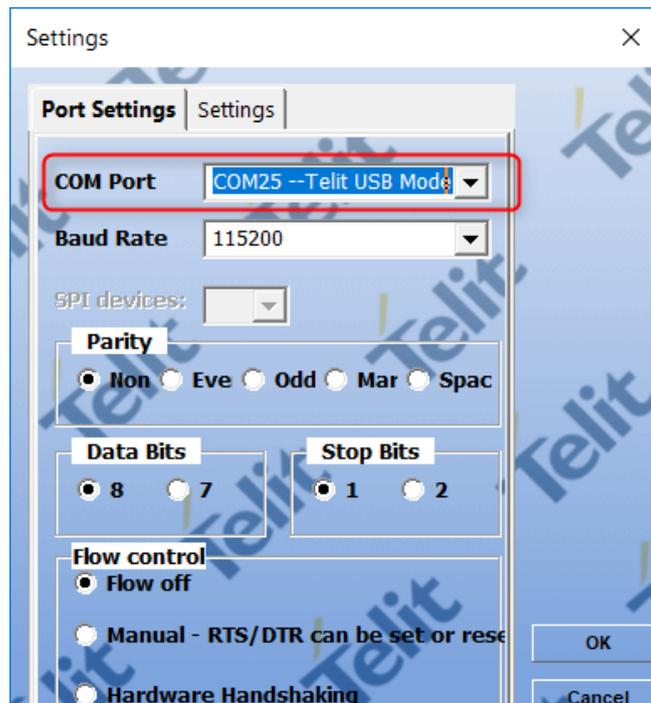
Figure 33: Select COM Port

3) After successful configuration of the Telit AT Controller, press the **Connect** button to connect to the module and receive the device information.

Figure 34: Telit AT Controller Device Information

4) Next, start the AT Terminal to communicate with the module using the AT commands.
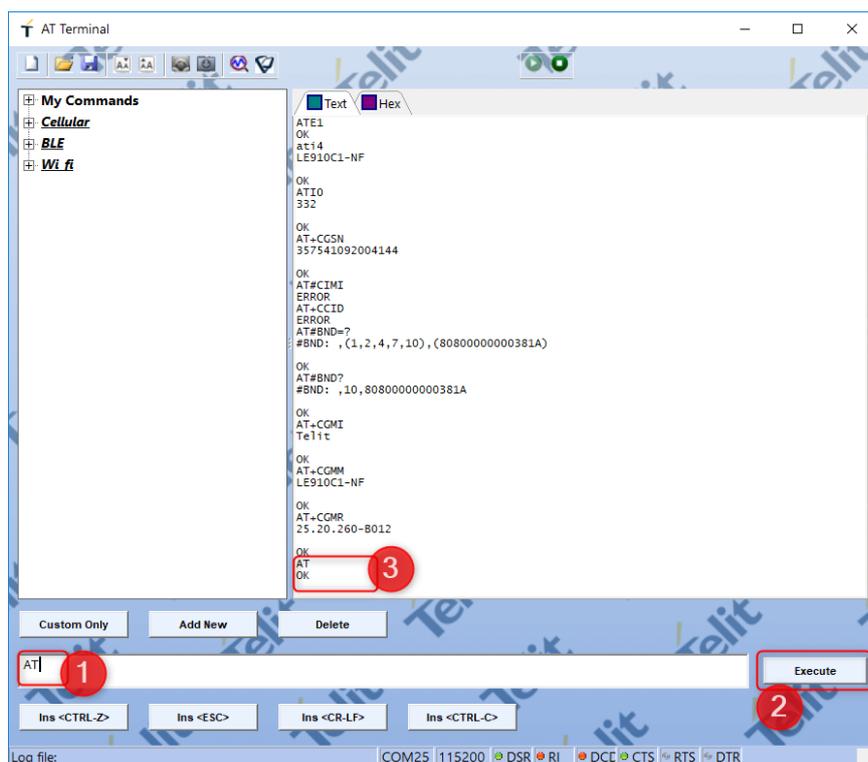
Figure 35: Communication via AT Commands

5.6. Setting Cellular Data Connectivity

1) Open the Network Settings on your Windows Laptop.

2) Enable the Cellular Settings.
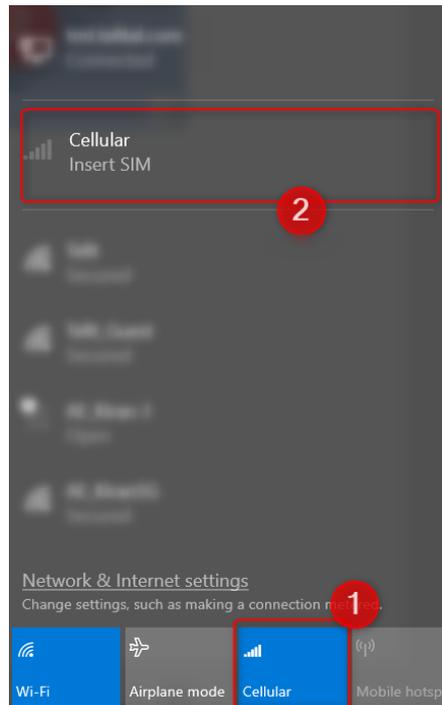
Figure 36: Enable Cellular Settings

3) Next, insert the SIM Card into EVB's Sim Slot. The Windows Laptop shows the Cellular network.
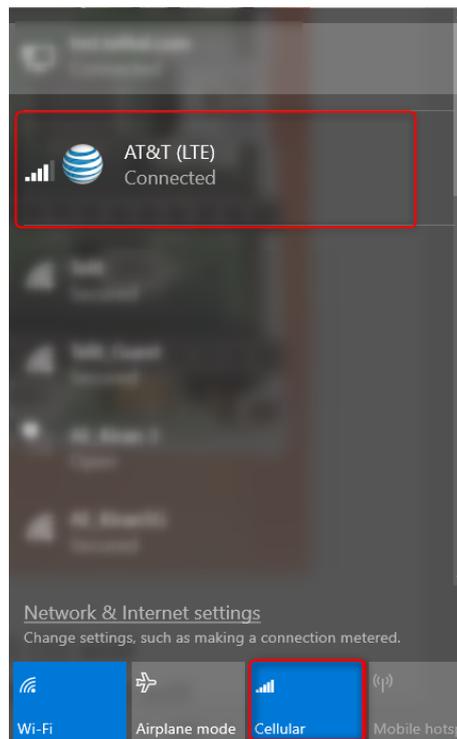
Figure 37: Cellular Network Identified

4) Uncheck **Let Windows Manage This Connection** to disconnect the laptop from using the cellular network. This step allows cellular data connection to be used by Telit EVB rather than Windows Laptop.
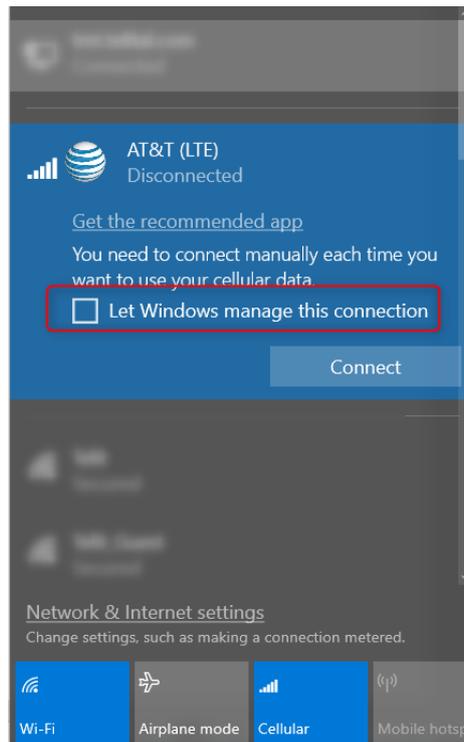
Figure 38: Disconnect Laptop

5) Execute the following Commands to make sure the LTE connectivity is Active for the SIM.

- AT+CMEE=2 – Error Message Information: This commands Returns the Details of Error in Verbose Mode

- AT+COPS? - Operator Selection: Give the information about Connected Cellular Operator's network

- AT+CPIN? - SIM PIN status: This command will return SIM PIN status; READY means device is not waiting for SIM PIN.
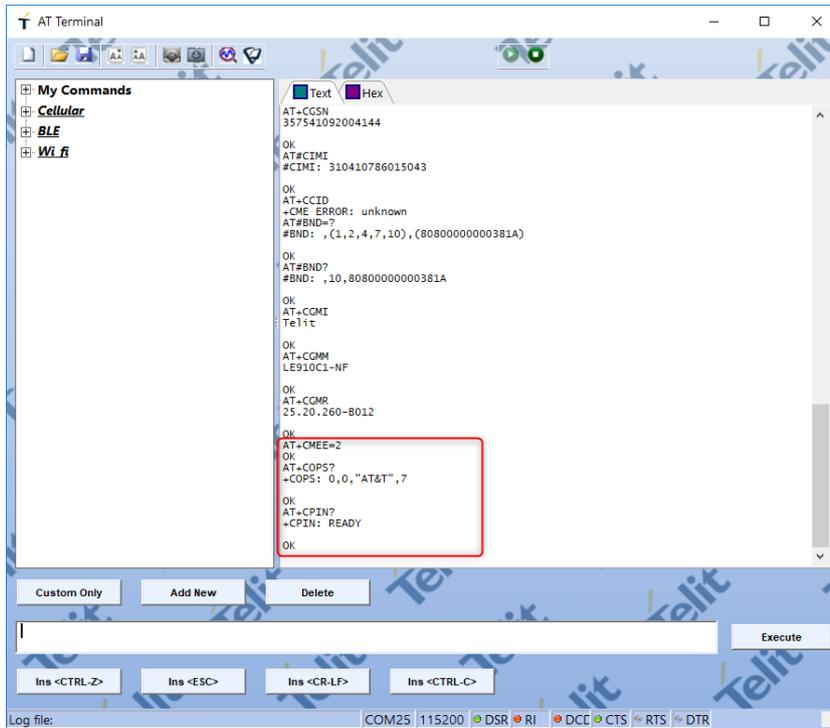
Figure 39: Execute AT Command for LTE Connectivity

Note: If cellular data is not Active for the SIM, the AT+WLANSTART=1 WLAN command returns an Error response.

6. WIRELESS OPERATIONS

This chapter describes the use cases for Wireless operations in the WE866Cx module.

6.1. Wi-Fi

6.1.1. Wi-Fi HotSpot Mode

6.1.1.1. Accessing Internet through Cellular Hotspot Mode

The WE866Cx module operates in AP mode. The internet connectivity for the Wi-Fi module is provided via cellular modem.

The Host MCU uses the AT commands to access the internet through the cellular connection, whereas an external STA can connect to an AP.

The Routing function for the Wi-Fi module is provided by the Linux OS and is orthogonal to the data AT commands.
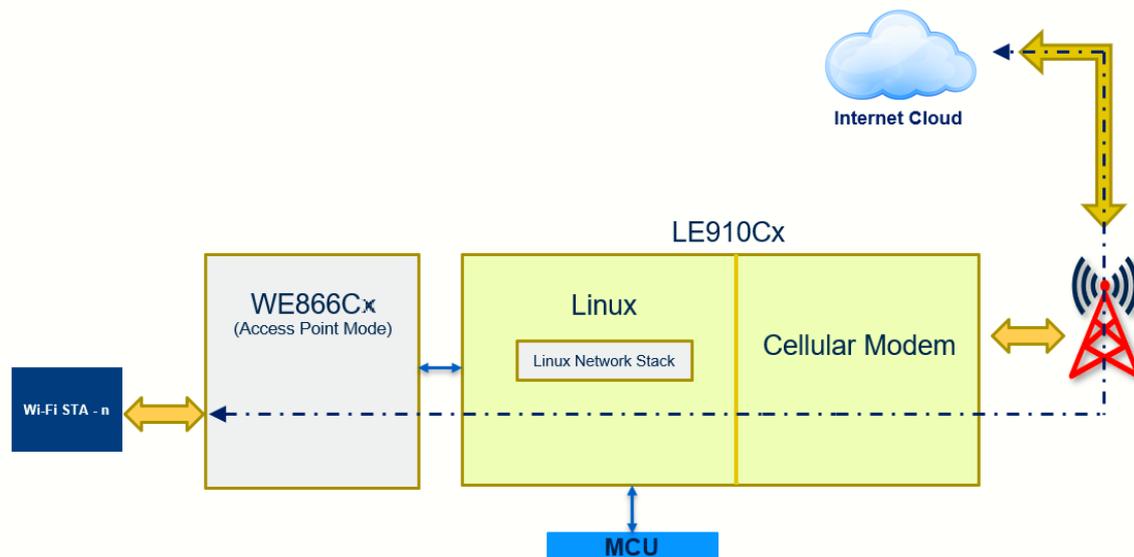
Figure 40: Accessing Internet through Cellular Modem

The following example demonstrates how to access the internet through cellular AT commands:

Step 1: Prepare the WE866Cx module for AP mode by issuing the following AT commands from Host MCU.

    AT+CGDCONT=1,"IP","Example_APN"

    AT+CGDCONT=2,"IP","Example_APN"

    AT#DUALAPN=1

AT#REBOOT

// "Example_APN" should be changed to the cellular provider's // APN. After changing DUALAPN mode, user must reboot for // changes to take effect.

// The above changes are persistent and must be done only // for the first time.

Step 2: Configure the WE866Cx module to AP mode using the following command

AT#WLANMODE=0

Step 3: Start the WE866Cx module

AT#WLANSTART=1

Step 4: Start a data connection in the modem side

AT#SGACT=2,1

The Linux and the host MCU will share the cellular data connection, and every STA connected to the device will be routed through the Linux platform.

6.1.1.2. Exchanging Data between MCU and Wi-Fi Station
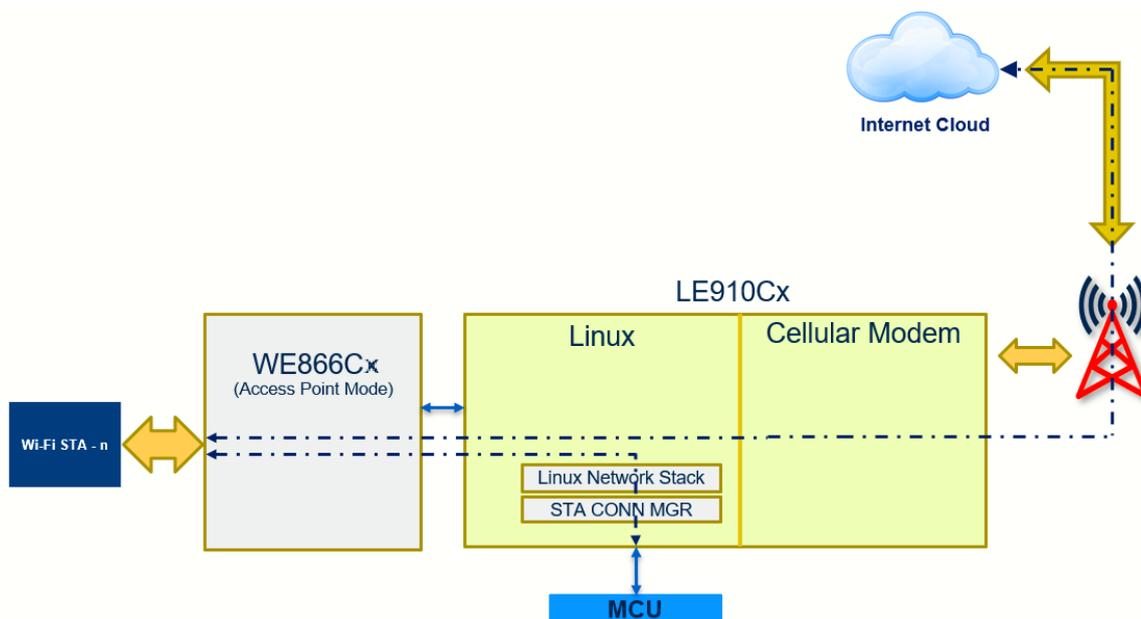
Figure 41: Exchanging Data between MCU & Wi-Fi STA

The following example demonstrates how to exchange data between MCU and Wi-Fi Station:

Step 1: Boot up the board

Step 2: Select USB composition as:

AT#USBCFG=13 or,

AT#USBCFG=14

Step 3: Run the WE866Cx Connection Manager using the following AT command

AT#CONNMGRSTART=1,0

Step 4: Enable WLAN using the following AT command

AT#WLANMODE=0 (Set WLAN mode AP)

AT#WLANSTART=1 (Enable WLAN interface and start AP)

Step 5: Start TCP server on remote device with IP Address: 192.168.43.105 and Port :8000

Step 6: Start TCP client on LE910Cx WLAN interface using following command,

AT#SD=101,0,8000,"192.168.43.105",0,9000,1,0,0

Note: Connection IDs – 101 to 106 are for WLAN Interface

Step 7: Send data using following command

AT#SSEND=101

Enter data when prompted and press **Ctrl-Z**

Step 8: Stop the WE866Cx Connection Manager using the following commands

AT#CONNMGRSTART=0

Step 9: To disable the WLAN, issue the following command

AT#WLANSTART=0

For more details regarding USB composition selection for WE866Cx Connection Manager, refer Chapter 7 Appendix.

6.1.2. Wi-Fi STA Mode

6.1.2.1. Exchanging Data with Cloud through Wi-Fi
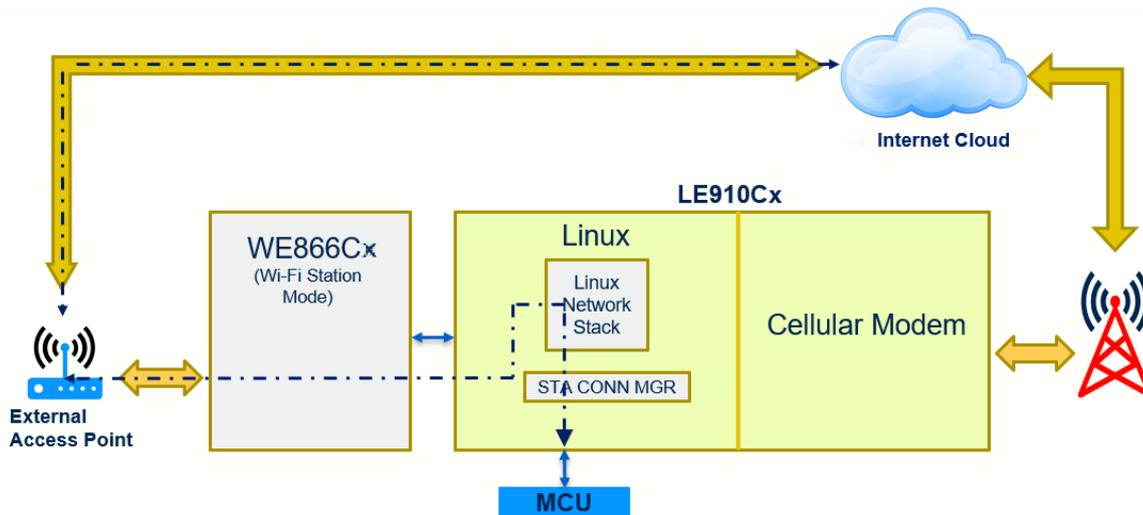
Figure 42: Exchanging Data with Cloud through Wi-Fi

The following example demonstrates how to exchange data in Wi-Fi Station mode:

Step 1: Boot up the board

Step 2: Select USB composition as:

AT#USBCFG=13 or,

AT#USBCFG=14

Step 3: Run the WE866Cx Connection Manager using the following AT command

AT#CONNMGRSTART=1,0

Step 4: Enable WLAN using the following AT command

AT#WLANMODE=1 (Set WLAN mode)

AT#WLANSTART=1 (Enable WLAN interface)

AT#WLANCONNECT=<SSID>,1,<PASSPHRASE> (Connect to the Access Point)

Step 5: Start TCP server on remote device with IP Address : 192.168.43.105 and Port :8000

Step 6: Start TCP client on LE910Cx WLAN interface using following command,

AT#SD=101,0,8000,"192.168.43.105",0,9000,1,0,0

Note: Connection IDs – 101 to 106 are for WLAN Interface.

Step 7: Send data using following command

   AT#SSEND=101

   Enter data when prompted and press **Ctrl-Z**

Step 8: Stop the WE866Cx Connection Manager using the following commands

   AT#CONNMGRSTART=0

Step 9: Disable the WLAN

   AT#WLANSTART=0

For more details regarding AT Commands, refer to LE910Cx AT Command Reference.

6.1.3.   Wi-Fi Concurrent Mode (Dual AP)

The WE866Cx module is a dual band 2.4 and 5GHz enterprise Wi-Fi module that supports simultaneous dual AP WLAN concurrent dual AP mode of operation. In this mode, the application starts two AP interfaces simultaneously: one AP interface operating in 2.4GHz frequency band and another AP interface operating in 5GHz band.

The Concurrent dual AP mode is supported via AT commands. The host MCU sends AT commands to start/stop the two AP interfaces and to switch between these AP interfaces.

Both the AP interfaces operate as hotspots and provide internet connectivity to their respective BSS stations.

The following steps are required to configure and use the dual AP mode:

Step 1: Prepare the WE866Cx module for AP mode by issuing the following AT commands from Host MCU

   AT+CGDCONT=1,"IP","Example_APN"

   AT+CGDCONT=2,"IP","Example_APN"

   AT#DUALAPN=1

   AT#REBOOT

// "Example_APN" should be changed to the cellular provider's // APN. After changing DUALAPN mode, user must reboot for // changes to take effect.

// The above changes are persistent and must be done only // for the first time.

Step 2: Configure WE866Cx module to WLAN dual AP mode using the following command

   AT#WLANMODE =3

Step 3: Enable WLAN start using the following command

AT#WLANSTART=1

Two AP mode interfaces with different BSSID will be started simultaneously: one AP interface operating in 2.4GHz frequency band and another AP interface operating in 5GHz band.

Step 4: Bring up a data connection in the modem side

AT#SGACT=2,1

Step 5: Select the AP interface to which further AT commands should be applied

- To select AP interface with 2.4GHz band, issue the following AT command

  AT#WLANCMIFSEL=0

- To select second AP interface (5GHz band), issue the following AT command

  AT#WLANCMIFSEL=1

Step 6: Configure the selected AP interface using the following commands (Optional)

AT#WLANSSID=<SSID>

AT#WLANSECURITY= =[[<wpa>],[<key_mgmt>,<pairwise>,<key>]]

AT#WLANPC=<mode>,<channel>

Note: These commands must be issued after issuing AT#WLANCMIFSEL command.

Step 7: To view the selected AP interface BSS details, issue the following commands

AT#WLANMAC

AT#WLANAPCLIST

Step 8: To disable the WLAN, use the following command

AT#WLANSTART=0

For more details regarding AT Commands, refer to LE910Cx AT Command Reference.

6.2.   Bluetooth Low Energy (BLE)

This section describes the use cases for BLE operations in the WE866Cx module.

6.2.1.   Exchanging Data between Host MCU to BLE Devices

6.2.1.1. Exchanging Data between WE866Cx Peripheral Mode and BLE Central Device

6.2.1.1.1.   Prerequisites

- LE910Cx and WE866Cx MI Card (Peripheral Device)

- Android/iOS Smartphone with nRF Connect Application installed from Google Play Store/App store (Central Device)

Note: Make sure the FPGA Switch Position on the Bundling EVK is at position 1

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Step 1: Boot up the board

Step 2: Select USB composition as:

AT#USBCFG=13

Step 3: Enable WLAN

AT#WLANSTART=1 (Enable WLAN interface)

Step 4: Run the WE866Cx Connection Manager on MODEM1 using the following AT command.

AT#CONNMGRSTART=1,0

If you are using MODEM2 with USB composition 13, use the following AT command

AT#CONNMGRSTART=1,1

Step 5: Enable Linux network stack

AT#ISEL=1

Step 6: Enable BLE

AT#BI=1,1

Note: The EVK boards without an AUX port use the alternate UART port by enabling the AUX Port Parameter on the BI Command.

Step 7: Add a new BLE service, using the following command

AT#BATTRIB="pserv","uuid=1234"

Make sure to add the services before the start of the first advertisement. If advertisement has already started, disable and enable BLE before proceeding with adding a new service.

- To add characteristics in a service, use the following commands

    AT#BATTRIB="char","prop=1A","uuid=12A1"

    AT#BATTRIB="charval","perm=0011","len=1","val=59"

    #BATTRIB:"CHARID:53"

    Where, 53 is the characteristic ID

    Once the characteristics are added, start the services using the following command

    AT#BATTRIB ="complete"

    #BATTRIB:"SRVID:51"

    Where, 51 is the service ID.

- To change the value of characteristic (CHARID:53) in the service (SRVID:51) use the following commands

    AT#BSRVDATAEX=51,53,"61"

Where, 61 is the new value of the characteristic (CHARID:53) in the service (SRVID:51)

Step 8: Now, set the BLE device name using the following command

    AT#BNAME="LE910-BLE"

Step 9: Start advertisement using the following commands

    AT#BADVE=1 (with custom advertisement data)

    AT#BADVE=0 (without custom advertisement data)

Step 10: Scan for device name "LE910-BLE", and connect to LE910 peripheral using nRF connect app on your smartphone.

Step 11: Once the central BLE device is successfully connected to LE910 peripheral, read and write operations can be performed.

Step 12: To stop advertisement, use the following commands

    AT#BADVE=3

    AT#BADVE=2 (reserved for future use)

Step 13: To disable BLE

    AT#BI=0

Step 14: To disable WLAN

    AT#WLANSTART=0

6.2.1.2. Exchanging Data between LE910Cx Central Mode and BLE Peripheral Device

6.2.1.2.1. Prerequisites

- LE910Cx and WE866Cx MI Card (Central Device)
- Android/iOS Smartphone with nRF Connect Application installed from Google Play Store/App store (Peripheral Device)

The following example demonstrates the steps required to exchange data between LE910Cx Central Mode and BLE Peripheral device.

Step 1: Boot up the board

Step 2: Select USB composition as:

AT#USBCFG=13

Step 3: Enable WLAN

AT#WLANSTART=1 (Enable WLAN interface)

Step 4: Run the WE866Cx Connection Manager on MODEM1 using the following AT command

AT#CONNMGRSTART=1,0

If you are using MODEM2 with USB composition 13, use the following AT command

AT#CONNMGRSTART=1,1

Step 5: Enable Linux network stack

AT#ISEL=1

Step 6: Enable BLE

AT#BI=1,1

Note: The EVK boards without an AUX port use the alternate UART port by enabling AUX Port Parameter on the BI Command.

Step 7: Scan for peripheral device using the following command

AT#BSCAN (To scan all the nearby devices)

AT#BSCAN="008025D1D7B2" (To scan device with MAC address 008025D1D7B2)

Step 8: Now, connect the device using the following command

AT#BCONNECT="008025D1D7B2","t2"

Where, 008025D1D7B2 is the MAC address of the peripheral device and,

"t2" is the type of the device (t2: public address, t3: random address)

Note: While initiating a connection to a random address, perform a scan first. The device should appear in the scan result.

Once the connection is established, a connection ID is displayed. For example, "#BCONNECT: 5"

Step 9: To discover the services of the connected peripheral devices:

- Discovery of all primary services in the connected device with connection ID

AT#BSRVD=5,,

#BSRVD:UUID:1800
#BSRVD:UUID:1801
#BSRVD:UUID:180A
#BSRVD:UUID:1234

OK

- Discovery characteristics of the primary service "1234"

  AT#BSRVD=5,"1234",

  #BSRVD:UUID:1234
  CHARUUID:3456
  CHARHNDL:23
  CHARPROP:3E
  CHARUUID:3457
  CHARHNDL:26
  CHARPROP:08

  OK

Step 10: To read on a characteristic, use the following command

AT#BREAD=5,23

#BREAD:5,23,"6162"

OK

Where, 23 is the characteristic handle

Step 11: To write on a characteristic, use the following command

AT#BWRITE=5,23,"7172"

Where, 23 is the characteristic handle and "7172" is the new value

Step 12: To disconnect the connected device, use the following command

AT#BDISCONNECT=4

Where, 4 is the connection ID

Step 13: To disable BLE

AT#BI=0

Step 14: To disable WLAN

AT#WLANSTART=0

6.2.2. GATT Setup

6.2.2.1. Exchanging Data between LE910Cx Peripheral Mode and BLE Central Device using Android nRF Connect Application

The following example shows the steps required to setup GATT using an android nRF Connect Application.

6.2.2.1.1. Prerequisites

- LE910C1-EU Bundling EVK Board (Peripheral Device)
- Android/iOS Smartphone with nRF Connect Application installed from Google Play Store/App store (Central Device)

Step 1: Boot up the board

Step 2: Select USB composition as:

AT#USBCFG=14

Step 3: Change the WLAN mode

AT#WLANMODE=1

Step 4: Run the WE866Cx Connection Manager on MODEM1 using the following AT command

AT#CONNMGRSTART=1,0

Step 5: Enable Linux network stack

AT#ISEL=1

Step 6: Enable BLE

AT#BI=1,1

Note/Tip: The EVK boards without an AUX port use the alternate UART port by enabling AUX Port Parameter on the BI Command.

Step 7: Add a new BLE service, using the following command

AT#BATTRIB="pserv","uuid=1234" AT#BATTRIB="char","prop=1A","uuid=12A1"

AT#BATTRIB="charval","perm=0011","len=1","val=59" AT#BATTRIB ="complete"

Step 8: Now, set the BLE device name using the following command

AT#BNAME="LE910-BLE"

Step 9: Start advertisement using the following commands

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AT#BADVE=1

> **Note:** Once the USBCFG value is set on the bundling EVK, the COM port gets disconnected. The user must select the new COM port by searching in device manager.

Step 10: Scan for device name "LE910-BLE", and connect to LE910 peripheral using nRF connect app on your smartphone.

Step 11: Once the connection is established, bond the bundling EVK to the smartphone using the below AT Command

AT#BSSPCONF="Smartphone Address","t2",1 1

A pin confirmation is received on the EVK for a bonding request.

> **Note:** According to the BLE SIG Standard, the default Command Timeout value is 30 seconds. If no connection is established during this connecton timeout period, the connection procedure gets terminated and the user has to initiate the process from the beginning.

6.2.2.2. Exchanging Data between LE910Cx Central Mode and BLE Peripheral Device with GATT Attributes

The following example demonstrates the steps required to setup GATT to read the Attributes and Services using a BLE Peripheral device.

6.2.2.2.1. Prerequisites

- LE910 Bundling EVK Board (Central Mode)
- BlueMod+S50 module (Peripheral Device)

Step 1: Boot up the Board

Step 2: Select USB composition as:

AT#USBCFG=14

Step 3: Change the WLAN mode

AT#WLANMODE=1

Step 4: Run the WE866Cx Connection Manager on MODEM1 using the following AT command

AT#CONNMGRSTART=1,0

Step 5: Enable Linux network stack

AT#ISEL=1

Step 6: Enable BLE

AT#BI=1,1

Note: The EVK boards without an AUX port use the alternate UART port by enabling AUX Port Parameter on the BI Command.

Step 7: Next, enable GATT Attributes on BlueMod +S50 Peripheral device using the following command:

ATI99

AT+BOAD

AT+BNDDEL=*

AT&F1

AT&W

AT+RESET

AT+LEROLE=0

AT+LEADE=1

AT+LEATTRIB=pserv,uuid=180F

AT+LEATTRIB=char,prop=12

AT+LEATTRIB=charval,uuid=2A19,perm=0001,len=1

AT+LEATTRIB=COMPLETE

Step 8: After the GATT service setup is completed, initiate a scan for the peripheral device on the LE910 EVK

AT#BSCAN (To scan all the nearby devices)

Step 9: Once the BlueMod+S50 EVK is visible on the scan list, initiate a connection to the BLE EVK

AT#BCONNECT="Peripheral BLE Address","t2"

Where, "t2" is the type of the device (t2: public address, t3: random address)

Once the connection is successful, a connection ID is displayed on the LE910 (central).

Step 10: To discover the services of the connected peripheral devices, use the below commands.

AT#BSRVD=<CONNECT ID>,,

AT#BSRVD=<CONNECT ID>,<UUID>

AT#BREAD=CONNECT ID,CHAR HANDLE

Step 12: To disconnect the connected device, use the following command

AT#BDISCONNECT=4

Where, 4 is the connection ID

Step 13: To disable BLE

AT#BI=0

Step 14: To disable WLAN

AT#WLANSTART=0

6.2.3. BLE Web Provisioning

The following steps are required to perform BLE web provisioning.

Step 1: Boot up the board

Step 2: Select USB composition

AT#USBCFG=13

Step 3: Enable WLAN

AT#WLANSTART=1 (Enable WLAN interface)

Step 4: Run the WE866Cx Connection Manager on MODEM1 using the following AT command.

AT#CONNMGRSTART=1,0

If you are using MODEM2 with USB composition 13, use the following AT command

AT#CONNMGRSTART=1,1

Step 5: Enabling Linux network stack

AT#ISEL=1

Step 6: Enable BLE

AT#BI=1

Step 7: Set the device name using the following command

AT#BNAME="we866cx_445566"

Where, 445566 is the last part of your MAC address.

Step 8: Start BLE web provisioning using the following command

>   AT#BWNWEBPROV=2

Step 9: Now, open the provisioning app on the phone and scan for devices.

Once the "we866cx_445566" device appears in the scan list, connect to device.

Step 10: Upon successful connection, the App initiates scan and the LE910 device reports the Wi-Fi scanned networks to the App.

Step 11: On the App, select the network to be connected. If prompted, enter the required credentials.

The App will send the Wi-Fi AP details to the LE910 device. Upon successful reception of the details, the device connects to the selected Wi-Fi network and reports the status (success/failure).

> **Note:** If provisioning fails using the Android Application, remove the Bluetooth cache files from the phone's internal system settings. Once the cache is cleared, provisioning will be successful.

6.3. HTTP

This section describes the use cases for HTTP command operations in an WE866Cx Connection Manager application.

6.3.1. HTTP Mode Commands

Step 1: Configure HTTP profile, for basic HTTP operations

>   AT#HTTPCFG=100,"server_addr","server_port",0,,,0,120,1,0

This command configures a basic HTTP profile, without any server authentication.

The HTTP commands support three profile IDs, range between 100-102. The server address input can be given as IPv4 address or Domain name of the HTTP server.

> **Note:** <cid> parameter is mandatory, but it is not used.

Step 2: Receive data from HTTP server, using GET method

>   AT#HTTPQRY=100,0,"/resource_path/"

>   #HTTPRING message will be sent to host MCU, when response is received from HTTP server.

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Note: <extra_header_line> parameter is not used

Step 3: Read data received from the HTTP server

AT#HTTPRCV=100,0

<maxByte> can specify the number bytes to be read

Step 4: Send data to HTTP server, using POST method

AT#HTTPSND=101,0,"/resource_path/",2048

Note: <post_param> and <extra_header_line> parameters are not used.

6.3.2.   HTTPS Mode Commands

Step 1: Configure the HTTPS profile with server CA certificate validation

AT#HTTPCFG=101,"server_addr","server_port",0,,,1,120,1,1

Note: For WE866Cx Connection Manager, <UNUSED1> parameter can be set to 0 or 1. <UNUSED1> parameter is considered as a new HTTP configuration "<ssl_verify>", and is used to enable/disable CA certificate validation.

Step 2: Enable SSL security configuration

AT#SSLEN=101,1

SSL commands support only one <SSId> value, that is 101.

Step 3: Store HTTPS server Root CA certificate

AT#SSLSECDATA=101,1,1,4096

Note: CA certificates in ".PEM" format only are supported.

Issuing ESC char does not ensure the elimination of partial inputs. Therefore, it is recommended to delete the previous CA certificate, before storing another CA certificate.

Step 4: Configure system time by issuing the below command

AT+CCLK="19/12/06,08:52:00+12"

Note: +CCLK command supports only local time zone. The Network Time synchronization is NOT supported.

Once the HTTPS profile is configured, the GET and POST methods can be tested as explained in section 6.3.1 HTTP Mode Commands.

6.3.3.   HTTP/HTTPS Server Authentication

To enable the basic server authentication, configure the HTTP/HTTPS profile using the below command

AT#HTTPCFG=102,"server_addr","server_port",1,"username","password",0,120,1

Once the profile has been successfully configured with the server authentication credentials, the GET and POST methods can be tested as explained in sections 6.3.1 HTTP Mode Commands and 6.3.2 HTTPS Mode Commands.

7. APPENDIX

7.1. WE866Cx Connection Manager

WE866Cx Connection Manager is a Linux application running on apps processor enabled for bundling Wi-Fi features. It is supported on USB compositions 13 and 14.

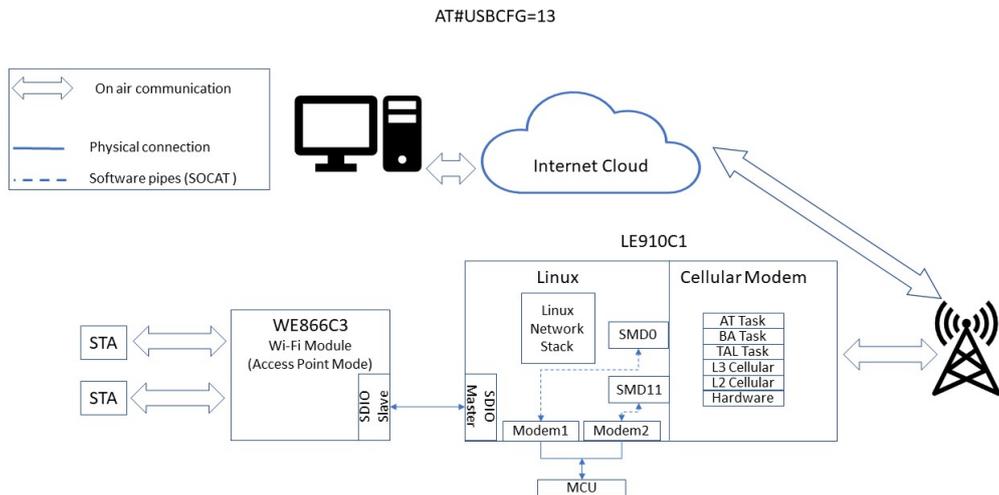- In USB compositions 13, WE866Cx Connection Manager is supported on MODEM1 and MODEM2.

Figure 43: USB Composition-13 Selection for WE866Cx Connection Manager

- In USB composition 14, WE866Cx Connection Manager is supported only on MODEM1. MODEM2 is used only for cellular commands.
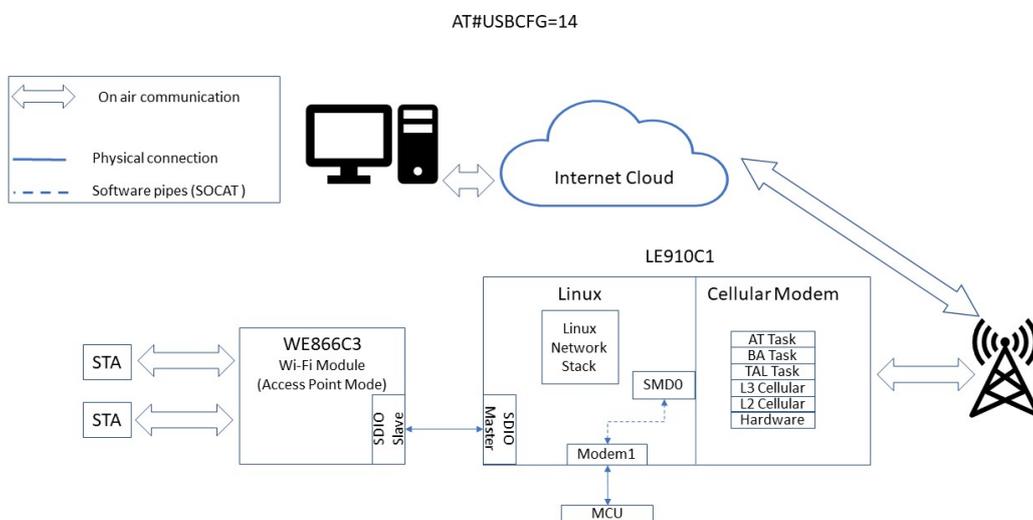
Figure 44: USB Composition-14 Selection for WE866Cx Connection Manager

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- When WE866Cx connection manager is started, the SOCAT pipe is broken and the AT commands issued through MODEM ports are intercepted and data is sent through the selected interface.

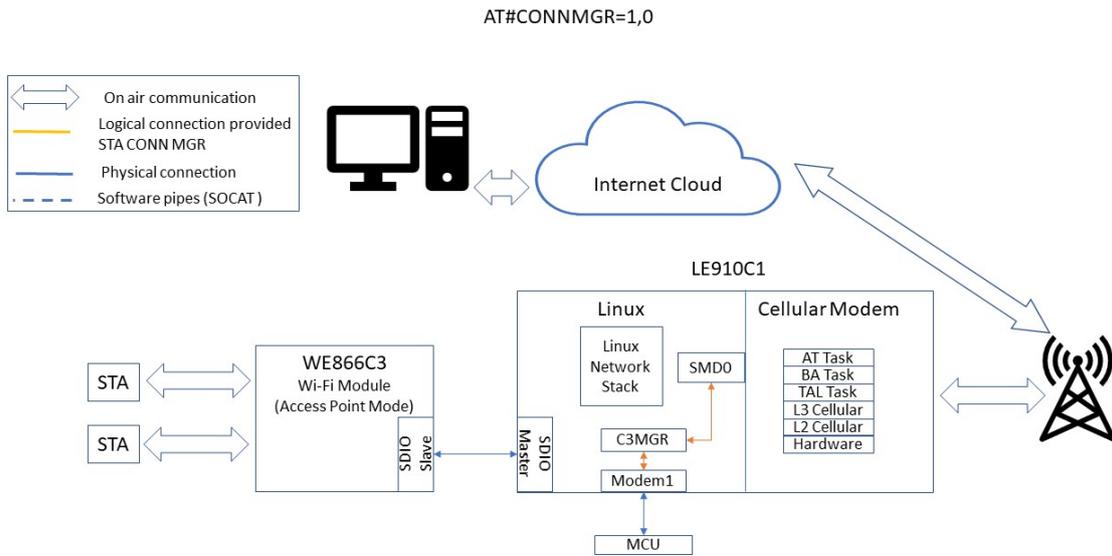*Figure 45: Connection established via WE86CC3 Connection Manager*

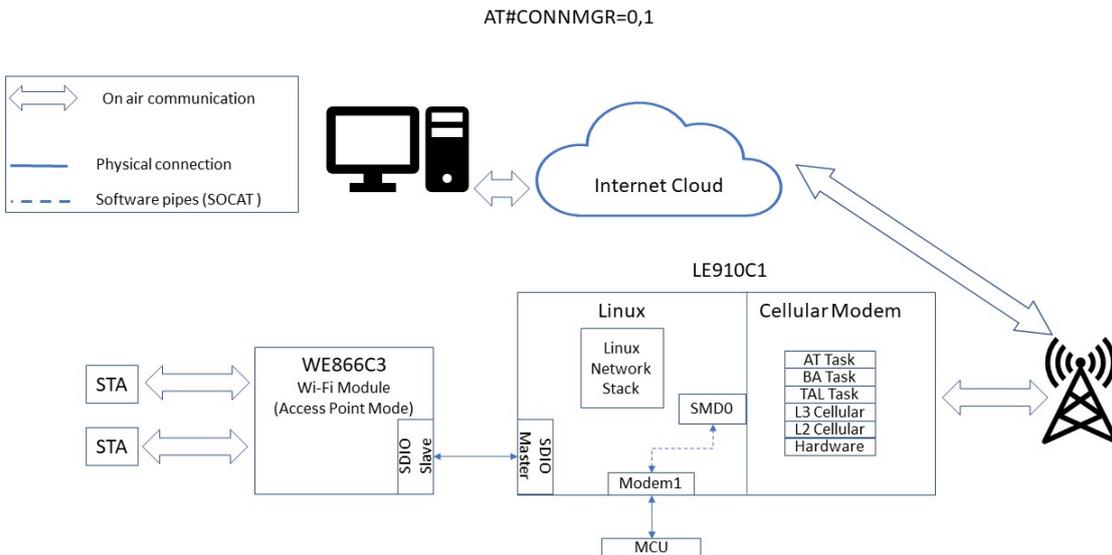- When WE866Cx connection manager is killed, the SOCAT link is re-established.

Figure 46: Connection Established via SOCAT Links

Not Subject to NDA

7.1.1. Enabling WE866Cx Connection Manager

Perform the following steps to enable the WE866Cx Connection Manger:

1) Select the USB composition

   AT#USBCFG=13 or,

   AT#USBCFG=14

2) Run the connection Manager

- To run the connection manager on MODEM1, issue the following commands

   AT#CONNMGRSTART=1,0

- To run the connection manager on MODEM2, using USB Composition 13 issue the following commands

   AT#CONNMGRSTART=1,1

7.1.2. Disabling WE866Cx Connection Manager

To stop running the WE866Cx Connection Manager issue the following commands

AT#CONNMGRSTART=0

7.2. Firmware Update

The WE866Cx manager can be updated using existing FOTA solution, either through MCU or directly from LE910Cx.

To update the WE866Cx manager, please refer to the existing FOTA solution AT commands.

7.3. Limitations and Known Issues

7.3.1. AT Commands

Following is the list of NOT Supported AT Commands:

AT command	Remarks
ATS2	
ATS3	
ATS4	
ATS5	
ATS7	

- Socket Last Closure command (AT#SLASTCLOSURE) displays zero when socket is closed.

- HTTP methods HEAD, DELETE, PUT are NOT supported

- #HTTPSND <data_len> parameter supports maximum data length of 2048 characters

- #HTTPRING <content-type> parameter is always "text/html; charset=UTF-8"

- #SSLSECCFG commands are NOT supported

- #SSLSECDATA command supports only CA certificates in ".PEM" format

- After terminating #SSLSECDATA command using ESC char, delete certificate command should be issued

- +CCLK command supports local time zone only.

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- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.
- there is a risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product. Therefore, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed carefully in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1:2014.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

https://ec.europa.eu/growth/sectors/electrical-engineering_en

9. GLOSSARY

BLE	Bluetooth Low Energy
EVB	Evaluation Board
FOTA	Firmware Over-the-Air
GND	Ground
GPS	Global Positioning System
HTTP	HyperText Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IFBD	Interface Board
JTAG	Joint Test Action Group
LTE	Long-Term Evolution
MTB	MultiTech Interface Board
PCM	Pulse-Coded Modulation
SDIO	Secure Digital Input Output
SSL	Secure Sockets Layer
TATC	Telit AT Controller
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
WHQL	Windows Hardware Quality Labs
WLAN	Wireless Local Area Network

10. DOCUMENT HISTORY

Revision	Date	Changes
11	2021-04-27	Minor changes on the language Minor changes in the layout Legal Notices updated
10	2020-07-30	Added section 6.2.2 GATT Setup Added prerequisities under section 6.2.1 Exchanging Data between host MCU to BLE Devices.
9	2020-05-22	Added Chapter 8 Acronyms Added the following sections: 5.2 Installing WHQL Drivers 5.3 Installing TATC Tool Setting Cellular Data Connectivity Updated sections 5.1 Prerequisites, 5.4 Start Up, and 5.5 Configuring WE866Cx Module Changed the document name to "LE910Cx-WE866Cx LTE Bundling User Guide" to incorporate the WE866C6 module.
8	2019-12-12	Added following sections: 0 Bluetooth Low Energy (BLE) 6.3 HTTP 7.2 Firmware Update Updated section 7.1 WE866Cx Connection Manager with SOCAT connection information Updated section 7.3 Limitations and Known Issues with BLE and HTTP limitations
7	2019-11-07	Corrected Product Applicability Table
6	2019-10-25	Added Wi-Fi concurrent mode details
5	2019-05-17	Corrected AT#CONNMGRSTART command value for disabling WLAN under the following sections: 6.1.2 Exchanging Data between MCU and Wi-Fi Station 6.2.1 Exchanging Data with Cloud through Wi-Fi 7.1.2 Disabling WE866Cx Connection Manager Updated sections 7.3.2 Features and 7.3.3 Others

Revision	Date	Changes
4	2019-05-15	Added information related to AT#SSENDUDPEXT command under section 7.2 Limitations and Known Issues. Corrected Connection ID for WLAN interface under section 6.1.2 Exchanging Data between MCU and Wi-Fi Station and 6.2.1 Exchanging Data with Cloud through Wi-Fi
3	2019-05-07	Modified Chapter 6 Wireless Operations to add new enhancement and other features. Replaced Chapter 7 AT Commands with Appendix
2	2019-03-29	Removed the following AT Commands which are not supported. • AT#WLANMAC • AT#WLANSWV
1	2019-02-25	Modified description for the following AT Commands • AT#WLANSECURITY • AT# WLANMACMODE • AT#WLANPC
0	2019-01-11	First issue

From Mod.0818 rev.3

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